

# Basinwide Subsurface Stratigraphic Architecture and Wireline Facies Distribution of Leonardian Bone Spring Units in the Delaware Basin of New Mexico and Texas

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## Abstract

The Leonardian part of the Bone Spring Formation (BSPG; Lower Permian) consists of six mappable units that are commonly named the 1st, 2nd, and 3rd BSPG ‘sandstones’ and the 1st, 2nd, and 3rd BSPG ‘limestones’. The siliciclastic-dominated units (i.e., the ‘sandstones’) cyclically alternate with the carbonate-dominated units (i.e., ‘limestones’). Sequence stratigraphic analysis of Sierra Diablo outcrops of BSPG equivalents by Fitch (1997) suggests that each of the 1st, 2nd, and 3rd BSPG siliciclastic-carbonate couplets represent three, high-frequency sequences (HFS). In basinal geographic positions, each HFS is predominantly comprised of a siliciclastic-dominated unit representing the lowstand system tract and an overlying carbonate-dominated unit that represents the highstand systems tract. My subsurface observations, which are derived from correlations and mapping of the BSPG interval in more than 4,600 wells throughout the Delaware Basin of southeast New Mexico and west Texas, confirm Fitch’s interpretations. Further, I have mapped sandstone and carbonate facies end members (estimated from geophysical log curves) to delineate sediment dispersal patterns within the respective highstand and lowstand system tracts that comprise each of the three BSPG high-frequency sequences (e.g., 1st, 2nd, and 3rd BSPG). Bone Spring carbonate-dominated units are generally much thicker (up to 3,000 ft; 915 m) immediately adjacent to shelf margin sources and they typically thin into the basin. Carbonate materials were shed off the adjacent

shelves by gravity and current-driven forces and formed thick, carbonate-dominated slope deposits during highstands of relative sea level. BSPG siliciclastic units tend to be thickest (up to 1,000 ft; 305 m) in the northern Delaware Basin, north of the Grisham fault and they thin toward the basin margins, suggesting that these sediments largely bypassed the carbonate-dominated slopes and infilled the deep basin during lowstands. Sandstone-dominated slope fan complexes occur locally, e.g. basinward of the NW Shelf margin. This work has been performed as part of the Bureau of Economic Geology's Tight Oil Resource Assessment (TORA) project, which aims to provide detailed, geologically based resource estimates of Wolfcampian and Leonardian unconventional reservoirs in the Permian Basin and integrate them with engineering and economic analyses.